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USE OF FRUITS IN ICE CREAM AND RELATED PRODUCTS¹

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During the rationing of sugar, the shortage of certain ice-cream ingredients, and the severe governmental curtailment of milk solids for ice-cream, there is one important means of maintaining production and sales, namely, the use of more fruit in commercially prepared frozen desserts. Many ice-cream makers have already taken advantage of this possibility and are increasing their output of sherbets and ices. There are, however, attendant dangers. To maintain satisfactory quality under the limitations imposed, extra precautions will be required in freezing and subsequent handling. The following information may be helpful.

Because of their tartness or acidity, they are thirst quenchers, refreshing summer desserts.

Available Forms.--Normally, fruits for ice-cream may be had fresh, dried, canned, frozen-pack, and candied; also as juices, sirups, concentrates, and special products. At present, however, only certain of the fresh fruits are readily available; and most of the other products are either rationed or scarce. Probably some dried figs, second-quality dates, prunes, and raisins can be obtained, especially just after their dry-ing seasons. Cut dried fruits are scarce. In



Fig. 1.--Frozen-fruit containers of large size consisting of cellophane bags inside fiberboard. (Courtesy, E. I. DuPont Company.)

Value of Fruits in Ice Cream.--Fruits are usually rich in vitamin C, of which milk and its products normally contain only a small amount. Fruits also afford minerals important in maintaining the acid-base balance of the body and in supplementing the minerals of dairy products.

Fruit ices and sherbets are lower in caloric (heat-producing) value than high-fat ice creams.

¹This wartime leaflet temporarily replaces Circular 331, Fruits in Ice Cream and Ices, now out of print.

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season, various fresh fruits can be utilized more extensively than in former years, although berries are scarce.

Preparing and Storing Frozen-Pack Fruits.--Most ice-cream factories have ample hardening-room space or can use such space temporarily during the fall and winter for storing frozen-pack fruits. In the larger cities, commercial freezing storage space can usually be rented, if the plant's own hardening-room is inadequate.

Under present regulations, sugar may be procured to pack fruits for freezing storage; and sugar so used would materially extend the supply of the factory.

As a rule, too, the ice-cream producer can secure locally grown fruits for use fresh in ice

cream and for storing in frozen form. But for strawberries and raspberries, which are now scarce, he must find substitutes. In ices and sherbets, Santa Rosa, Satsuma, and other red-fleshed plums are very satisfactory; Muscat, Concord, and Pierce Isabella grapes have pronounced flavors that carry well. Persimmons and avocados make excellent ice creams, while freestone peaches, apricots, and several varieties of pears give attractive frozen desserts. From individual fresh-fruit-packing houses, from growers, or through the large fresh-fruit-shipping companies, one can often purchase fresh fruits whose quality is second or cull in so far as the fresh market or canning is concerned. The prices of these are usually low to moderate. If sound, ripe, and free from rot or insects, such fruit is very acceptable for ice cream, ices, and sherbets. In certain areas fresh figs are abundant in season.

When packed for freezing storage, fruit should be either crushed or covered with liquid; otherwise browning, oxidation, and loss of flavor may unfit them for use. Crushing is better than packing in light sirup or water; the product occupies less space, is more easily thawed, and has a more suitable texture for use in ice cream.

Frozen fruits may be stored in: ice-cream cans; 30-pound egg tins (now scarce); wooden kegs; cryovac; heavy pliofilm; bags of cellophane, or similar material, supported inside stiff fiberboard cartons (fig. 1); or large paraffined fiberboard tubs or buckets.

Stem, sort, and wash berries. Crush. Add 1 pound of sugar to 3 or 4 of fruit. Stir till the sugar is completely dissolved; otherwise, much of it will sink, forming a thick layer in the bottom. Pack in suitable containers, preferably not larger than 10 gallons; leave enough head space for expansion during freezing. If very large containers, such as 25- or 50-gallon barrels, must be used, precool the stemmed, washed berries overnight at 32° F. Chill the dry sugar and barrels overnight in the hardening room at not above 10° F before filling the barrels with crushed berries and sugar. Without this precooling, much of the fruit will ferment or mold before it can cool sufficiently to keep.

Pit and peel peaches and avocados. Pit well-ripened plums, but do not peel. Let pears ripen thoroughly, but not to mushiness; peel, halve, and core. Grind coarsely. Add 1 pound of sugar to 4 of fruit. Pack. Store in the hardening room as for berries.

Stem figs. Sort carefully. Wash. Grind. Add 1 pound of sugar to 4 or 5 of fruit. In other respects, proceed as with apricots.

Use persimmons soft ripe. Remove stems and peel. Rub through tinned screen to give a smooth pulp and to remove the seeds. Add 1 pound of sugar to 4 of fruit.

Remove Concord, Pierce Isabella, and red wine grapes such as Alicante or Zinfandel from the stems. Crush. Heat to 175° F in a steam-jacketed kettle; drain through cotton sugar bags, pressing out as much of the juice as possible.

If a little water is added to the pressed skins, additional color and thin juice will be obtained. Ream out the juice from citrus fruits. Cover red plums with water, boil 3 minutes, then strain and press like grapes. The juices may be kept in freezing storage without sugar though the flavor is better retained if 1 to 1½ pounds of sugar is added to each gallon of juice.

Using Frozen Fruits.--Frozen fruits and juices should be well thawed before adding to the mix; otherwise the large crystals formed during storage will persist in the ice cream. The fruit can be thawed quickly if the can is placed in hot water and the contents stirred as the thawing progresses; or the contents can be emptied into a kettle and warmed. Apricots, peaches, and pears, if not previously heated or blanched, should be melted in a kettle and quickly brought to a boil in order to destroy the enzymes that cause browning and stale flavor in the frozen dessert. Do not, however, heat persimmons, avocados, and citrus juices, for heat will ruin the flavor of the two fruit pulps and seriously damage that of the citrus. If these precautions are taken, frozen-pack fruits can be used like the fresh or canned.

If sugar is added to the fruit in the amounts recommended in the preceding section, further sweetening usually will not be needed although some may be necessary for sherbet or ice. Of course these fruits, like the fresh, are not used undiluted; they are added to basic ice-cream, sherbet, or water-ice mix in the proper proportions.

Ice-Cream Mixes.--A very satisfactory composition for ice cream is 12 per cent fat, 10 per cent milk-solids-not-fat, 15 per cent sugar, and enough gelatin or other acceptable stabilizers to maintain the desired smoothness in the frozen product. Egg-yolk solids (about ½ per cent) may be added, but are not necessary. Much of the ice-cream mix made in California has had essentially this composition; and, with only slight modifications, the formula can still be used.

A number of federal restrictions have been imposed upon the industry. Food Distribution Administration Order No. 8, in effect since February 1943, limits the milk solids in frozen dairy products to 65 per cent of the total milk solids used in a corresponding month during the base period (December 1, 1942). It further limits the milk-solids content to 22 per cent, with the further provision that the milk-solids-not-fat content of ice cream may not be more than 80 per cent of the fat content. This regulation has markedly affected the composition of ice cream.

Recent experiments in the Dairy Industry Division of the University were designed to ascertain the minimum milk-solids-not-fat contents acceptable in commercial ice cream. From 8 to 8.5 per cent milk-solids-not-fat proved to be required with a mix containing 10.5 per cent fat, 14 per cent sugar, and 0.4 per cent gelatin; from 9 to 9.5 per cent for a mix identical with the above

except that it contained only 8 per cent fat. Although such mixes can be used for fruit ice cream, they are not optimum in composition; hence greater care, especially in freezing, will be required to secure the desired texture.

A satisfactory basic mix for sherbets and ices is the following: Cane or beet sugar 21 pounds; pure corn sugar 7 pounds; agar-agar, highest grade powdered, $2\frac{1}{2}$ ounces (0.15 pound); powdered pectin or gum tragacanth, $5\frac{1}{2}$ ounces (0.35 pound). Make to 100 pounds by adding fruit or fruit juice and water. To this mixture add enough citric, tartaric, or lactic acid to give an acidity of 0.35 to 0.50 per cent. Ordinarily this is about 6 to 7 ounces of acid per 100 pounds of final mix.

Citric acid is now very scarce, being needed in certain war industries. Lemon juice, if available, may be substituted for it in acidifying the mix. Lemon juice contains about 6 per cent of citric acid. To secure the equivalent of 6 to 7 ounces of the acid, it would be necessary, therefore, to use 100 to 116 fluid ounces of juice, or $6\frac{1}{4}$ to $7\frac{1}{4}$ pints. In other words, 1 pint of juice contains about 1 ounce of acid.

When samples were experimentally flavored with orange, grapefruit, pineapple, strawberry, and Boysenberry, lactic acid proved to be equal to citric and tartaric acids for standardizing the acidity in ice and sherbet mixes. From 0.35 to 0.50 per cent acid gave the most satisfactory results. To produce a given degree of tartness, one might expect to use more of the lactic acid than of the citric or tartaric. The results, however, showed little or no difference in the amounts required. Recently saccharic acid has been tried with pineapple as the flavor. It will serve, but seems less satisfactory than the other acids mentioned. From 0.5 to 0.6 per cent acid calculated as saccharic gave the best results in these comparisons.

Proper acidity is extremely important in ices and should therefore be carefully standardized. The optimum total acidity is considered to be 0.35 to 0.55 per cent, as determined by titrating a 10-gram sample in 50 cubic centimeters of water with N/10 sodium hydroxide and phenolphthalein indicator. For a 10-gram sample, the cubic centimeters of N/10 NaOH \times 0.0064 \times 10 gives the per cent total acid as citric.

Example: If 7 cubic centimeters of N/10 NaOH is used, then $7 \times 0.0064 \times 10 = 0.468$ per cent. For other details see Circular 333, Methods of Standardizing Ice-Cream Mixes (revised 1943), or any good text on ice-cream making.

Ordinarily not less than 20 per cent fruit or fruit juice is used in ices or sherbets. In most cases, larger amounts are more pleasing. High appetite appeal is sometimes secured by blending mild-flavored fruits such as pears and apples with fruit of more pronounced flavor such as Boysenberry, Youngberry, and Santa Rosa plum. For regular ices, 25 to 35 per cent overrun is best; but with sherbets, overruns can be slightly higher. D. G. Sorber of the U.S. Department of Agriculture has made high-fruit-content ices

using fruits singly or blending fruits as described above. Overruns comparable with those used for ice cream give satisfactory results with such products.

Typical Fruit Ice-Cream Formulas.--Commercial formulas are apt to err in the direction of too little rather than too much fruit.

When ice cream is frozen in a batch freezer, the fruit should be added early in the process. If, however, the sugar content of the individual fruit particles is made high enough to prevent them from forming hard, icy pieces, they may be added at the end of the freezing or stirred into the ice cream after it is drawn. If added after freezing, the fruit should be cold and the ice cream well frozen; otherwise a coarse texture will result. Special injectors are used to mix fruit with the ice cream as it comes from "continuous" freezers. In such injectors, however, the juice and sirup are drained from the fruit and added to the mix before freezing; and only fruit particles well impregnated with sugar are used.

There are various ways of measuring mix and fruit. A convenient method for a 10-gallon-batch freezer is to weigh out the prepared fruit, add enough mix to make 45 pounds, and freeze to 100 per cent overrun, thus obtaining 10 gallons of ice cream.

To make fresh apricot, peach, pear, or nectarine ice cream proceed as follows: Pit apricots. Pit and peel peaches or nectarines. Peel, halve, and core pears. Grind coarsely. Add 2 pounds of sugar to 8 pounds of fruit. Boil until cooked through, usually 3 to 5 minutes, to prevent browning and hardening in freezing. Cool. Add 7 pounds of the fruit to 38 pounds of mix. Freeze to optimum overrun.

Fig ice cream is made like apricot except that $7\frac{1}{2}$ pounds of fruit and $1\frac{1}{2}$ pounds of sugar are used.

Peel, pit and grind fresh avocados. Add 2 pounds of sugar to 8 pounds of fruit. Mix. Add 9 pounds to 36 pounds of basic mix. Freeze.

Persimmon ice cream is made like avocado. The fruit must not be heated.

Fresh berries are stemmed, washed, ground, and added directly to the ice-cream mix. At least 10 per cent should be added, preferably 25 per cent or more. Thus to 36 pounds of mix add 9 pounds of crushed berries. The use of relatively large proportions of fruit delays or prevents the stale flavor so frequently associated with strawberry ice cream.

Frozen-pack fruits are first thawed and then used in the same proportions and manner as the fresh.

Prunes make an excellent ice cream. Wash and sort. Cook in water to cover until soft. Cool. Rub through a screen or colander to remove pits. Add 7 to 9 pounds of the pulp to 36 to 38 pounds of basic mix.

Use seeded muscat raisins. Add to 5 pounds, 3 pints of water. Heat to 165° F. Stir. Let stand for 2 hours. Grind one half of the raisins;

leave the other half whole. Add both to 37 pounds of basic mix.

Low-sugar mixes may be used when dates are to be the source of flavor. To a mix containing 12 per cent fat, 10.5 per cent milk-solids-not-fat, 10 per cent sugar, and 0.35 per cent gelatin, a very pleasing and characteristic date flavor was imparted by adding about 12½ per cent pitted ground dates. Nut meats made this even more pleasing. The Khadrawi and Deglet Noor varieties were used singly; also a blend of several varieties. Though all the samples were satisfactory, the Khadrawi variety was less stringy and also milder. Heating the ground dates with part of the mix, before freezing, facilitated the dispersion of the fruit and did not impair the date flavor. All the judges agreed that the samples were sweet enough. When the mix contained 15 per cent sugar, the date ice cream was criticised as too sweet.

Water Ices and Sherbets.--Directions for making fresh-plum ice, as experimentally made, are as follows: Wash ripe red or black plums. Crush. To 10 pounds add 1 gallon of water. Boil 4 to 5 minutes. Strain through a cotton sugar bag or rub through a fine sieve to remove pits and skins. Use 3½ to 4 gallons of pulp or juice to make 100 pounds of basic ice mix. Freeze to about 30 per cent overrun.

For a good orange ice use 30 to 35 per cent of fresh orange juice in the basic mix. A little orange oil and a trace of color (not too much) may be required.

Cut pomegranates in half. Squeeze in an apple-juice press, and use the juice in water ice. Do not grind the fruit before pressing, or the juice will be too puckery for use.

To 10 pounds of pitted, ground, ripe, fresh

apricots add 2½ pounds of sugar. Boil 3 to 5 minutes. Cool. Use 20 to 25 per cent in the basic mix. Freeze to not more than 35 per cent overrun.

Fresh peach ice can be made in a similar manner except that more fruit will be required.

Fresh apple juice from local presses can be used very successfully in ices. Use 50 per cent or more in the basic mix.

The frozen-pack fruits and juices may be treated like the fresh. Most dried fruits are not very satisfactory in ices; but cooked, sieved dried apricots can be used in ices and sherbets. Dried fruits, however, are now seldom available.

Bottled and canned juices are excellent in ices and sherbets, but at present are very scarce.

In making sherbets, milk instead of water may be used in the basic mix, essentially as with basic ice mixes. More commonly, however, a basic ice mix is prepared, and one of the following products is added just before or during the freezing: 10 to 15 per cent ice-cream mix, 10 to 15 per cent condensed skim milk, 3 to 5 per cent skim-milk powder.

Fruit Mixtures.--Various fruit blends or mixtures may be used to advantage in ices, sherbets, and ice creams. Canned fruit cocktail is a good example. A pleasing mixture consists of 6 pounds each of crushed apricots, peaches, and berries with 4½ pounds of sugar, brought to the boiling point and cooled. Many other combinations can be used.

Specialties.--Formulas for Nesselrode pudding, au fait, frappes, mousses, and other specialties appear in any good text on ice-cream manufacture. They do not appropriately fall within the scope of this leaflet.